Universitat de Lleida

DEGREE CURRICULUM

THERMODYNAMICS AND CHEMICAL KINETICS

Coordination: DAVID , CALIN ADRIAN

Academic year 2023-24

THERMODYNAMICS AND CHEMICAL KINETICS 2023-24

Subject's general information

<table>
<tr><td>Subject name</td><td>THERMODYNAMICS AND CHEMICAL KINETICS</td></tr>
<tr><td>Code</td><td>102216</td></tr>
<tr><td>Semester</td><td>2nd Q(SEMESTER) CONTINUED EVALUATION</td></tr>
<tr><td>Typology</td><td>
<table>
<tr><th>Degree</th><th>Course</th><th>Character</th><th>Modality</th></tr>
<tr><td>Bachelor's Degree in Food Science and Technology</td><td>1</td><td>COMMON/CORE</td><td>Attendance-based</td></tr>
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<tr><td>Course number of credits (ECTS)</td><td>6</td></tr>
<tr><td>Type of activity, credits, and groups</td><td>
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<tr><th>Activity type</th><th>PRALAB</th><th>PRAULA</th><th>TEORIA</th></tr>
<tr><td>Number of credits</td><td>0.8</td><td>1</td><td>4.2</td></tr>
<tr><td>Number of groups</td><td>4</td><td>1</td><td>1</td></tr>
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<tr><td>Coordination</td><td>DAVID , CALIN ADRIAN</td></tr>
<tr><td>Department</td><td>ENVIRONMENT AND SOIL SCIENCES AND CHEMISTRY</td></tr>
<tr><td>Teaching load distribution between lectures and independent student work</td><td>60 contact hours
90 hours of student work</td></tr>
<tr><td>Important information on data processing</td><td>Consult this link for more information.</td></tr>
<tr><td>Language</td><td>Spanish</td></tr>
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THERMODYNAMICS AND CHEMICAL KINETICS 2023-24

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
DAVID , CALIN ADRIAN	calinadrian.david@udl.cat	6,8	
SALVADOR TUREGANO, JOSE	jose.salvador@udl.cat	1,6	

Learning objectives

The student, upon passing the subject, must be able to:

1. Know how to use the concept of chemical potential

2. Know how to apply the conditions of chemical and phase equilibrium and the main characteristics of each of them

3. Know the main features of colloidal systems

4. Know the bases that govern the behavior of non-equilibrium systems: Transport phenomena and chemical reactivity

5. Know the concepts and methodologies used in determining the speed of a chemical reaction as well as the basis of the main theories that allow justifying the speed of the processes

6. Relate the acquired chemical physical concepts with those of mathematics, physics and biology.

7. Quantitatively solve the problems that arise in practice in the laboratory with the determinations that involve the concepts mentioned in the subject using specialized computer programs where appropriate

Competences

At least the following basic competences will be guaranteed:

CB4: That students can transmit information, ideas, problems and solutions to both specialized and non-specialized audiences.

CB5: That students have developed those learning skills necessary to undertake further studies with a high degree of autonomy.

General competencies

In addition, the graduate must be able to:

CG2: Interpret studies, reports, data and analyze them numerically.

GC3: Select and use available written and computerized sources of information related to the professional activity.

GC5: Understand and express themselves in the appropriate terminology.

GC6: Discuss and argue in different forums.

GC10: Have a critical and innovative spirit.

CT3: Use existing computer and communication tools as a support for the development of their professional activity (strategic competence UdL).

Specific competences

CE2: Identify and apply the chemical fundamentals necessary for the development of other disciplines and activities of the profession.

CE5. Apply the basic processes of a laboratory and use equipment, handle reagents, comply with safety conditions and prepare reports.

CE6. To pose and solve problems by correctly applying the acquired concepts to concrete situations.

Translated with www.DeepL.com/Translator (free version)

Subject contents

THEORETICAL CONTENTS:

Unit 1.- Principles of Thermodynamics (2 T + 3 P)

Introduction. First Principle. Enthalpy. The second principle of thermodynamics. Microscopic meaning of entropy.

Unit 2.- Thermodynamic equilibrium (2 T +4 P)

Gibbs and Helmholtz function. Chemical potentials. Phase equilibrium and chemical equilibrium conditions. Thermodynamic relationships. Calculation of variations in state functions for different processes.

Unit 3.- Chemical potential and activity. (4 T +5 P + 4 L)

Partial molar magnitudes. Mixing quantities. Chemical potentials for gases. Ideal solutions. Ideal diluted solutions. Non-ideal solutions. Activity and activity coefficient. Scales. Colligative properties. Electrolyte solutions. Debye-Hückel theory.

Unit 4.- Chemical equilibrium in non-ideal systems. (2 T +4 P)

The equilibrium constant. Dependencies. Balance displacements.

Unit 5.- Phase equilibrium. (2 T +4 P)

Phase balances in 1-component systems. Clapeyron equation. Two-component phase diagrams: Liquid-vapor, liquid-liquid, and solid-liquid balance. Structure of the phase diagrams. Three component systems.

Unit 6.- Chemistry of surfaces. (2 T + 3 P)

Interface. Surface thermodynamics. Superficial films. Adsorption. Colloids.

Unit 7.-Electrochemistry and Battery. (2 T + 3 P)

Redox reactions. Faraday laws. Electrode potentials. Battery thermodynamics: Nernst equation. Concentration stacks. Applications.

Unit 8.- Kinetics of reactions. (4 T + 10 P + 4 L)

Determination of the kinetic equations. Reaction mechanisms. Approximation of the limiting stage and the steady-state. Influence of temperature on kinetic constants. Experimental techniques for the measurement of reaction rates. Solution reactions. Catalysis. Enzymatic catalysis. Inhibition. Heterogeneous catalysis. Photochemistry. Dynamic theories of chemical reactivity.

Methodology

Master classes.

Problems and questions discussion with small groups.

Laboratory sessions with the aim of knowing the laboratory safety procedures and the techniques useful for the subject.

Development plan

Learning activities

Activity type	Description	Contact activity student		Activitat no presencial Alumne		Evaluation	Total time	
		Target	Hours	Student work	Hours	Hours	Hours	ECTS
Master class	Master class (Classroom. Large group)	Explanation of the main concepts	**20**	Study: Gain, understant and synthesize knowledge	**28**	**2**	**50**	**2**
Problems and cases	Participative session (Classroom. Large group)	Resolution of problems and cases	**22**	Learn to solve problems and cases	**32**	**2**	**56**	**2.2**
Seminar	Participative session (Small group)	Conducting discussion activities	**10**	Solve problems and cases. To argue	**20**	**1**	**31**	**1**
Laboratory	Laboratory session (Small group)	Practice development: understanding phenomena, measuring...	**8**	Write a report	**4**	**1**	**13**	**0.8**
Total			**60**		**84**	**6**	**150**	**6**

Evaluation

Activity type	Evaluation activity		Percentatge grading
	Procedure	Number	(%)
Master class	Written tests of the theoretical program of the subject	2	35
Practice cases	Case studies deliveries or written tests	4	5
Laboratory	Delivery of reports. Written or oral tests2	2	5

Total			100

EVALUATION

It consists of two mid-term exams with questions and problems. The weight of each of the mid-term exams is 35%.

During the course there will be different controls (problems, questions and practice reports) with a value of up to 30% of the grade of the midterm.

FINAL GRADE: average of the grades of the mid-term exams, provided that each mid-term grade is higher than 3.5.

The laboratory practicals are OBLIGATORY. It is also obligatory to attend the laboratory with a suitable lab coat, notebook and calculator. It is necessary to attend within the group that each one belongs, if it is necessary to make some justified change it is necessary to comment it with the responsible teacher previously. No change of practice group will be accepted without the approval of the coordinator. For repeaters who passed the internship the previous year, the internship is not mandatory.

In the same way, those students who can demonstrate the impossibility of attending class during the course for work reasons, may request at the beginning of the course (to the head of studies of the center) an alternative evaluation that will take place on the same day of the second partial exam and will count 90% of the final grade of the course. These students will be obliged to attend the practicals and will be evaluated in these contents through a report, which will contribute to the remaining 10% of the final grade of the course.

Bibliography

• LEVINE, I.N. - 2003 - Físico-química. - McGraw-Hill. Quinta edición • ATKINS, P.W. - 1999 (6ª Ed.) - Química Física - Ediciones Omega.
• CLARET, J., MAS, F., SAGUÉS, F .- Termodinámica Química y Electroquímica. Libros del Index. Barcelona 1996.
Bibliografía Complementaria
• AGUILAR, A, GÓMEZ, E y LUCAS, J. M. -1997- Cinética Química -Libros del Index. Universidad
• HIEMENZ, P. C-1997 (3ª Ed) - Principles of Colloid and Surface Chemistry- Marcel Dekker, Inc.